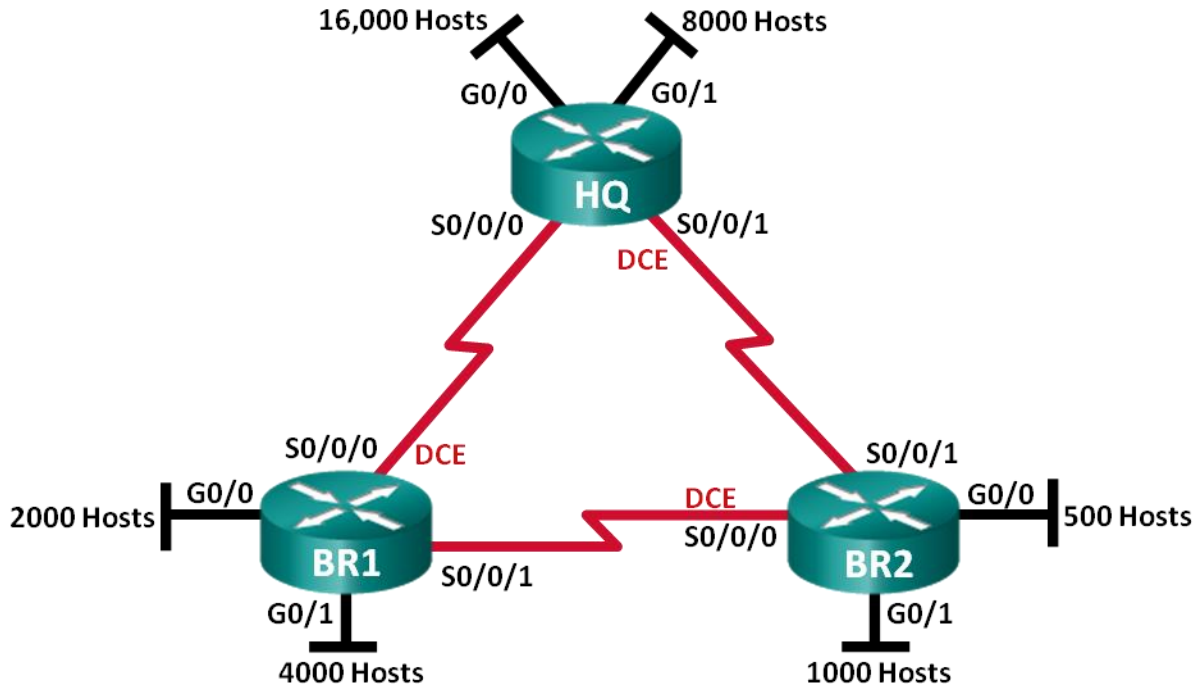


# Lab – Designing and Implementing IPv4 Addressing with VLSM

## Topology



## Objectives

- Part 1: Examine the Network Requirements
- Part 2: Design the VLSM Address Scheme
- Part 3: Cable and Configure the IPv4 Network

## Background / Scenario

The Variable Length Subnet Mask (VLSM) was designed to help conserve IP addresses. With VLSM, a network is subnetted and then subnetted again. This process can be repeated multiple times to create subnets of various sizes based on the number of hosts required in each subnet. Effective use of VLSM requires address planning.

In this lab, you are given the network address 172.16.128.0/17 to develop an address scheme for the network shown in the Topology diagram. VLSM will be used so that the addressing requirements can be met. After you have designed the VLSM address scheme, you will configure the interfaces on the routers with the appropriate IP address information.

**Note:** The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). Other routers and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

**Note:** Make sure that the routers have been erased and have no startup configurations. If you are unsure, contact your instructor.

### Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 1 PC (with terminal emulation program, such as Tera Term, to configure routers)
- Console cable to configure the Cisco IOS devices via the console ports
- Ethernet (optional) and serial cables as shown in the topology
- Windows Calculator (optional)

### Part 1: Examine the Network Requirements

In Part 1, you will examine the network requirements to develop a VLSM address scheme for the network shown in the Topology diagram using the network address of 172.16.128.0/17.

**Note:** You may use the Windows Calculator application and the [www.ipcalc.org](http://www.ipcalc.org) IP subnet calculator to help with your calculations.

#### Step 1: Determine how many host addresses are available and how many subnets are needed.

How many host addresses are available in a /17 network?

What is the total number of host addresses needed in the topology diagram?

How many subnets are needed in the network topology?

#### Step 2: Determine the largest subnet needed.

Subnet description (e.g. BR1 G0/1 LAN or BR1-HQ WAN link)

How many IP addresses are needed in the largest subnet?

What is the smallest subnet that supports that many addresses?

How many host addresses does that subnet support?

Can the 172.16.128.0/17 network be subnetted to support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

#### Step 3: Determine the second largest subnet needed.

Subnet description

How many IP addresses are needed for the second largest subnet?

What is the smallest subnet that supports that many hosts?

How many host addresses does that subnet support?

Can the remaining subnet be subnetted again and still support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

**Step 4: Determine the next largest subnet needed.**

Subnet description

How many IP addresses are needed for the next largest subnet?

What is the smallest subnet that supports that many hosts?

How many host addresses does that subnet support?

Can the remaining subnet be subnetted again and still support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

**Step 5: Determine the next largest subnet needed.**

Subnet description

How many IP addresses are needed for the next largest subnet?

What is the smallest subnet that supports that many hosts?

How many host addresses does that subnet support?

Can the remaining subnet be subnetted again and still support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

**Step 6: Determine the next largest subnet needed.**

Subnet description

How many IP addresses are needed for the next largest subnet?

What is the smallest subnet that supports that many hosts?

How many host addresses does that subnet support?

Can the remaining subnet be subnetted again and still support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

**Step 7: Determine the next largest subnet needed.**

Subnet description

How many IP addresses are needed for the next largest subnet?

What is the smallest subnet that supports that many hosts?

How many host addresses does that subnet support?

Can the remaining subnet be subnetted again and still support this subnet?

What are the two network addresses that would result from this subnetting?

Use the first network address for this subnet.

**Step 8: Determine the subnets needed to support the serial links.**

How many host addresses are needed for each serial subnet link?

What is the smallest subnet that supports that many host addresses?

a. Subnet the remaining subnet and write the network addresses that result from this subnetting below.

b. Continue subnetting the first subnet of each new subnet until you have four /30 subnets. Write the first three network addresses of these /30 subnets below.

c. Enter the subnet descriptions for these three subnets below.

**Part 2: Design the VLSM Address Scheme**

**Step 1: Calculate the subnet information.**

Use the information that you obtained in Part 1 to fill in the table below.

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Subnet Description	Number of Hosts Needed	Network Address /CIDR	First Host Address	Broadcast Address
HQ G0/0	16,000			
HQ G0/1	8,000			
BR1 G0/1	4,000			
BR1 G0/0	2,000			
BR2 G0/1	1,000			
BR2 G0/0	500			
HQ S0/0/0 – BR1 S0/0/0	2			
HQ S0/0/1 – BR2 S0/0/1	2			
BR1 S0/0/1 – BR2 S0/0/0	2			

### Step 2: Complete the device interface address table.

Assign the first host address in the subnet to the Ethernet interfaces. HQ should be given the first host address on the serial links to BR1 and BR2. BR1 should be given the first host address for the serial link to BR2.

Device	Interface	IP Address	Subnet Mask	Device Interface
HQ	G0/0			16,000 Host LAN
	G0/1			8,000 Host LAN
	S0/0/0			BR1 S0/0/0
	S0/0/1			BR2 S0/0/1
BR1	G0/0			2,000 Host LAN
	G0/1			4,000 Host LAN
	S0/0/0			HQ S0/0/0
	S0/0/1			BR2 S0/0/0
BR2	G0/0			500 Host LAN
	G0/1			1,000 Host LAN
	S0/0/0			BR1 S0/0/1
	S0/0/1			HQ S0/0/1

### Part 3: Cable and Configure the IPv4 Network

In Part 3, you will cable the network topology and configure the three routers using the VLSM address scheme that you developed in Part 2.

### Step 1: Cable the network as shown in the topology.

### Step 2: Configure basic settings on each router.

- a. Assign the device name to the router.
- b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were hostnames.
- c. Assign **class** as the privileged EXEC encrypted password.
- d. Assign **cisco** as the console password and enable login.
- e. Assign **cisco** as the vty password and enable login.
- f. Encrypt the clear text passwords.
- g. Create a banner that warns anyone accessing the device that unauthorized access is prohibited.

### Step 3: Configure the interfaces on each router.

- a. Assign an IP address and subnet mask to each interface using the table that you completed in Part 2.
- b. Configure an interface description for each interface.
- c. Set the clocking rate on all DCE serial interfaces to 128000.  

```
HQ(config-if)# clock rate 128000
```
- d. Activate the interfaces.

### Step 4: Save the configuration on all devices.

### Step 5: Test Connectivity.

- a. From HQ, ping BR1's S0/0/0 interface address.
- b. From HQ, ping BR2's S0/0/1 interface address.
- c. From BR1, ping BR2's S0/0/0 interface address.
- d. Troubleshoot connectivity issues if pings were not successful.

**Note:** Pings to the GigabitEthernet interfaces on other routers are unsuccessful. The LANs defined for the GigabitEthernet interfaces are simulated. Because no devices are attached to these LANs, they are in a down/down state. A routing protocol must be in place for other devices to be aware of those subnets. The GigabitEthernet interfaces must also be in an up/up state before a routing protocol can add the subnets to the routing table. These interfaces remain in a down/down state until a device is connected to the other end of the Ethernet interface cable. The focus of this lab is on VLSM and configuring the interfaces.

## Reflection

Can you think of a shortcut for calculating the network addresses of consecutive /30 subnets?

### Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

**Note:** To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.